the first place, the student has never been taught arithmetic in relation to actual measurements, but has been exercised in fictitious transactions with oranges and nuts, rods, poles or perches, and vats into which liquor flows at the rate of so many gallons a minute and out of which it flows (notwithstanding the dwindling pressure) at another exact and steady rate. The result is that the student has no idea of the relation of magnitude to measurement, and no opinion whatever on the subject of significant figures; he cannot use logarithms or a slide-rule, and is unpractised in contracted methods of computation. In the second place, it is very likely that he has no sound idea of proportion. Given a student in this condition—and it is still the common case—the teaching of what is called chemical arithmetic becomes a serious part of the duties of a teacher of chemistry. The fundamental numbers of chemistry—the atomic weights—are proportional numbers, and it may be said without exaggeration that the failure to realise this and the inability to see how proportional numbers may be used for the calculation of absolute weights, locate the real *pons asinorum* of elementary chemistry.

In these circumstances any well considered attempt to expound the elements of chemical arithmetic is to be welcomed, and Prof. Wells has certainly succeeded in writing something on the subject which is likely to be very useful. He does not quite descend to the meanest capacity, but he deals in a very clear way with the meaning of figures and the limits of accuracy in measurement and computation. He also gives a good survey of the chief types of chemical problems, including all kinds of analyses and the corrections of gas volumes. Great pains are taken to impress the student with the importance of using common sense and judgment whilst performing arithmetical operations, and to this end set rules and stereotyped formulæ are avoided. An appendix to the book contains tables, including a well printed set of five-figure logarithms. Altogether the work is one that may be warmly recommended to the notice of English teachers.

A. S.

The Physics and Chemistry of Mining. By T. H. Byrom. Pp. xii + 160. (London: Crosby Lockwood and Son, 1905.) Price 3*s*. 6*d*. net.

THIS elementary class-book supplies information required for such examinations as the Board of Education principles of mining, stage i. The idea is a good one, as the principles of pure science upon which mining practice is based are apt to receive scant attention in mining classes. The author, who is chemist to an important colliery company, has, as lecturer at the Wigan Technical College, become acquainted with the needs of students, and he gives in concise form much useful information regarding the atmosphere, the laws relating to the behaviour of gases, the diffusion of gases, the composition of the atmosphere, water, carbon, fire-damp, combustion, coal dust, explosives, the composition of coals, the analysis of coal, the strata adjoining the Coal-measures, magnetism and electricity. The language is simple, and chemical symbols are sparingly used. There is, however, a want of uniformity in nomenclature that might confuse the beginner. The terms "carbonate of magnesium" (p. 96) and "magnesia carbonate" (p. 125), "iron oxide and aluminia" (p. 46) and "iron peroxide and alumina" (p. 125) are examples. The author, too, should not have included Cumberland hæmatite among the ironstones, nor granite among the strata adjoining the Coal-measures.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Absorption Spectrum of Benzene in the Ultra-violet Region.

IN the *Transactions of the Chemical Society* for August Messrs. Baly and Collie, referring to the previous work of Baly and Desch (*Trans. Chem. Soc.*, 1904, lxxxv., 1029, and 1905, lxxxvii., 766) on the absorption spectrum of acetylacetone and its derivatives and the conclusions arrived at, namely, that the absorption band is caused by dynamic isomerism, or rather isodynamic changes, are led to infer from the occurrence of bands in the spectrum of benzene that these also are caused by the making and breaking of the carbon bonds in the molecule of the substance. I have given a similar, but not identical, explanation of the cause of the bands in the spectra of uric acid, murexide, and the ureides, and have pointed out that there is but little difficulty in accepting a like explanation in order to account for the bands in aromatic hydrocarbons, seeing that this would harmonise with Kekulé's view of the constitution of benzene. The particulars are contained in two papers communicated to the Chemical Society on May 17, but as they are still unpublished I cannot refer to them in detail.

Messrs. Baly and Collie consider all the possible phases in change of linking between the six carbon atoms in benzene, and assign a band to each phase. In doing this they feel justified in assuming that an even number of carbon atoms is concerned in each individual process, and in accordance with chemical evidence it could scarcely be imagined otherwise. They argue that there are only seven different makings and breakings of bonds possible, to which seven different absorption bands should belong, and on investigating the spectrum of benzene they find only seven bands. Seven bands were photographed (*Phil. Trans.*, 1879), as they remark, by Hartley and Huntington, but no measurements are given. The wave-lengths of lines in the ultra-violet had not been determined at that time (1878), with the exception of the principal lines of cadmium measured by Mascart, hence the reason for the absence of measurements.

In a subsequent observation (Hartley and Dobbie, "Notes on the Absorption Spectrum of Benzene," *Trans. Chem. Soc.*, 1898, lxxiii., 695) seven bands were photographed and measured, but one of these appeared to differ from the others in constitution, and it was indicated as doubtful; it is also a feeble band. The general character possessed by the first six bands was most distinctly marked in the four strongest; each was stronger and generally sharper towards the side where the rays of shorter wave-lengths lie, and was weakened in the opposite direction, as if the bands were composed of groups of lines occurring closer together and being stronger towards the more refrangible edge. Baly and Collie appear to have overlooked some points of importance in this communication, since they state that Hartley and Dobbie found only six bands, and that the measurements of the actual heads of the bands are not given. They give a series of numbers derived from Hartley and Dobbie's measurements which for comparison with their own are printed in a parallel column. The gist of the paper by Hartley and Dobbie was to show the structure of the benzene absorption spectrum partly by measurements and partly by the aid of a photograph. The bands which distinctly showed the structure were numbered, but unfortunately the manner in which the photograph was reproduced failed to render delicate details which were visible on the original plate. The statements contained in the paper appear, however, to have been clearly and fully understood by W. Friederichs, who photographed the vapour of benzene with a Rowland grating. He found fifty-six bands of absorption in its spectrum in the ultra-violet, which are arranged in eight groups, and he compared the principal lines of each group with the

© 1905 Nature Publishing Group

points of maximum absorption, or most persistent edges in each of the bands measured by Hartley and Dobbie. This is shown in the following statement quoted from his paper (Wilhelm Friederichs, *Zeit. für wissenschaftliche Photographie*, B. iii., 154–164, 1905).

I have added in italics the wave-length numbers corresponding to Baly and Collie's oscillation frequencies for comparison :—

	Vapour. Friederichs. λ	Solution in alcohol. Hartley and Dobbie. λ	Difference.	Baly and Collie. λ
(1)	2670	2681	11	*2683*
(2)	2633	—	—	*2656*
(3)	2588	2599	11	*2610*
(4)	2526	2541	15	*2554*
(5)	2458	2485	27	*2484*
(6)	2404	2429	25	*2433*
(7)	2356	2376	20	*2380*
(8)	2305	2330	25	—

He points out that the bands of the substance in solution which without doubt correspond with those of the vapour are all shifted towards the red, as might be expected, but that the shift appears to be greater the smaller the wave-lengths of the absorbed rays. The comparison of Baly and Collie's numbers with those of Hartley and Dobbie is very interesting in this connection, inasmuch as they show a close general agreement in their divergence from the measurements of Friederichs. Furthermore, the following points may be noted :—

First, the omission of the second band in Hartley and Dobbie's spectrum; second, the omission of the eighth band by Baly and Collie; third, there is a close agreement between Hartley and Dobbie's and Baly and Collie's numbers in the first, fifth, sixth, and seventh bands, but the two sets of measurements for the third and fourth bands differ more widely than the others.

It may be mentioned that the second very narrow band is visible on the photographs taken by Hartley and Dobbie, though it can scarcely be considered as measurable; no doubt a longer exposure would have rendered it more plainly. Those who have measured similar series of bands in the visible region, for example, those in the spectrum of potassium permanganate, which are also eight in number, will appreciate the close approximation of the above figures.

W. N. Hartley.

Royal College of Science, Dublin, September 19.

Rhymes on the Value of π.

The following rhyme is in imitation of the French and German verses given in Nature (August 17) in which the number of letters in each word correspond to a numeral in the value of π. The three concluding lines are somewhat obscure; it seems to have occurred to the author that the method is a misuse of language, and he expresses the hope that Nature will take a more lenient view than Dr. Johnson might be imagined to express.

To the Editor of Nature.

Sir,—I send a rhyme excelling
3 1 4 1 5 9
In sacred truth and rigid spelling.
2 6 5 3 5 8
Numerical sprites elucidate
9 7 9
For me the lexicon's dull weight.
3 2 3 8 4 6
If "Nature" gain,
2 6 4
Not you complain,
3 3 8
Tho' Dr. Johnson fulminate.
3 2 7 9

F.R.S.

The Celtic Pony.

In a review, signed "R. L.," of "The Færöes and Iceland," in Nature of September 21 (p. 506), I was surprised to read that I had credited Prof. Ewart "with being the first to regard Przewalsky's horse as a variety of *Equus caballus*." I have just re-read the paragraph relating to the wild horse in my "Appendix on the Celtic Pony," and I can find no passage which, it seems to me, could by any possibility be made to bear this strange construction.

Sanson's subspecies *E. c. hibernicus* appears to include all the various ponies of the British Isles, the Breton in France, as well as the horses of Iceland, Norway, and Sweden. It has been recognised for some time past that the Icelandic horses are of two different types, while the Swedish horses are admittedly very mixed. Moreover, as a result of a recent tour in Norway, it has become evident to me that there are in that country at least two distinct kinds of native horses (represented by the pure fjord horse and the Gudbrandsdal horse). In view of these considerations, the statement that the Celtic pony is "probably inseparable" from the somewhat heterogeneous assemblage (as it now appears to be) included under *E. c. hibernicus* becomes a little obscure. But, as "R. L." points out, I did *not* make this statement. I grant, however, that it might have been better had I made some allusion to this matter.

But why I should have been expected in an "Appendix on the Celtic Pony" to have entered into a discussion as to the proper technical name to apply to *E. przewalskyi* or to have recorded an irrelevant criticism of Prof. Ridgeway's new name of *E. c. libycus*, I am at a loss to understand.

Francis H. A. Marshall.

The University, Edinburgh, September 24.

GREEK ARCHÆOLOGY.[1]

The archæologist justly ranks himself as a contributor to the world's knowledge on the same level as those who discover previously unknown forces in nature or new facts in the life-history of animals, extinct or living. Archæology, which is a branch of the great science of anthropology, discovers and correlates new facts in the early history of civilisation. Greek archæological discovery must always be of most especial interest, since it tells us of the origins of that early civilisation of the Mediterranean basin from which our present-day culture is derived. One of the most welcome yearly publications dealing with the subject is the "Annual of the British School at Athens," the tenth volume of which lies before us. It deals with the British work of 1903–4, besides containing independent articles on matters of archæological interest.

Dr. Arthur Evans's work at Knossos does not occupy so much space in the "Annual" as usual. The discoveries of the year, while most interesting, were not so new and epoch-making as those of former years, and the chief find, the tombs of "Ja'fàr's Papoúra" (τοῦ Τζαφὲρ ἡ Παποῦρα) and Isópata, are described by Dr. Evans in a separate communication to *Archaeologia*. The first-named tombs, on a hill north of the Knossian palace, were of various types; (1) chamber-tombs approached by a *dromos*; "in many cases these contained clay coffins, in which the dead had been deposited in cists, their knees drawn towards the chin"; (2) shaft-graves; (3) pit-caves, "or pits giving access to a walled cavity in the side below." In 2 and 3 the skeletons were extended at full length. On the hill of Isópata, about two miles north of Ja'fàr's Papoúra, a very fine tomb, no doubt that of a king, was found, with a smaller one by its side. The larger consisted of a square chamber of limestone blocks, eight metres by six, "with the

---

[1] "The Annual of the British School at Athens," No. x. Session 1903–4. (London: Macmillan and Co., Ltd.)

© 1905 Nature Publishing Group